IN THE UNITED STATES PATENT AND TRADEMARK OFFICE
(Case No. 06-559)

In the Application of:	)	
	)	
Crickmore et al.	)	Examiner: Samir M. Shah
	)	
Serial No. 10/586,105	)	
	)	Group Art Unit: 2856
Filed: July 14, 2006	)	
	)	Conf. No. 1740
Title: Improvements in and Relating to Accelerometers	)	

Mail Stop Appeal Brief - Patents
Commissioner for Patents
P.O. Box 1450
Alexandria, VA 22313-1450

APPEAL BRIEF

Dear Sir:

This Appeal Brief is submitted in accordance with the requirements of 37 CFR 41.37. The fee required by 37 CFR 41.20(b)(2) is submitted herewith.

I. REAL PARTY IN INTEREST

The real party in interest of this pending application is QINETIQ LIMITED, which is the owner by Assignment of the above-identified U.S. patent application.

II. RELATED APPEALS AND INTERFERENCES

There are no Appeals or Interferences related to the above-identified U.S. Patent Application.

III. STATUS OF THE CLAIMS

This application includes 22 claims. Claims 1-15, 17 and 20-22 are pending in the application and are the focus of this appeal. Claims 16 and 18-19 stand cancelled from the application.

A copy of claims 1-15, 17 and 20-22 involved in this appeal, are attached hereto in the Claim Appendix.

IV. STATUS OF AMENDMENTS

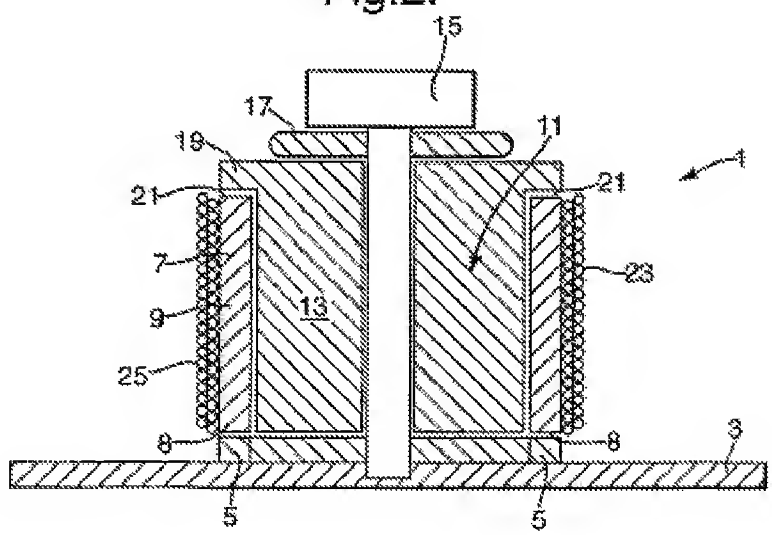
The amendments presented by the Applicant after the final rejection were entered by the examiner.

There are no amendments outstanding.

V. SUMMARY OF THE CLAIMED SUBJECT MATTER

The claimed invention is directed generally to fiber optic accelerometers and in particular fibre optic accelerometers that are useful in interferometers.

Fig.2.



In one embodiment, the present invention is a fibre optic accelerometer (1) comprising a seismic mass (13) coaxially constrained within a cylinder of compliant material (7) that is arranged to prevent the cylinder deforming inwardly under axial compression. The cylinder (7) is circumferentially wound with optical fibre (23) such that axial compression of the cylinder by the seismic mass (13) increases stress in the optical fibre. (*See, e.g.*, page 1, lines 25-27; page 2, lines 30-34; Claims 21-22).

Referring to Figure 2, above, the fibre optic accelerometer (1) is mounted on a base plate (3) via a rigid support ring (5). (*See, e.g.*, page 3, lines 17-24). Rigid support ring (5) can be

formed either as a relief in the base plate (3) or it can be provided as a separate component, thereby allowing differing sizes of accelerometer (1) to be mounted on base plate (3). (*See, e.g. Id.*). Base plate (3) is produced from a rigid material, typically steel. Furthermore, it is an aspect of this invention that base plate (3) also encompasses the direct mounting of the accelerometer to a platform or other structure. (*See, e.g. Id.*; Claim 8)

A rigid support ring (5) is placed in contact with a first end face of a compliant cylindrical member (7). (*See, e.g.*, page 2, lines 26-35;). The compliant cylindrical member (7) has relatively thin wall (9) and a coaxial void (or cavity) (11) such that a seismic mass (13) may be received therein. (*See, e.g.*, *Id.*; Claim 21). The compliant cylindrical member (7) can be formed from a material having a relatively low Young's modulus such that it is capable of deformation under low levels of loading in an axial direction. Typically, a rubber or rubber like material is used. (*See, e.g.*, *Id.*; Claim 20). Ideally, the inner surface of the cylinder (7) and outer surface of the seismic mass (13) are shaped so as to prevent the cylinder (7) deforming inwardly under axial compression of the cylinder. (*See, e.g.*, *Id.*; Claims 1, 15).

The seismic mass (13) is held by a tension member. In Figure 2, the tension member is a bolt (15) secured to the base plate (3). (*See, e.g.*, page 4, lines 1-14; Claim 4). In other embodiments, the tension member is provided by an enclosure or can. (*See, e.g.*, *Id.*). A bolt (15) bears on the seismic mass (13) via an elastomeric member which, in Figure 2, is a pad (17) of rubber of rubber-like material. (*See, e.g.*, *Id.*). The seismic mass (13) itself is shaped so a generally disc shaped portion (19) bears on a second end face (21) of compliant cylindrical member (7). (*See, e.g.*, *Id.*; Claim 3).

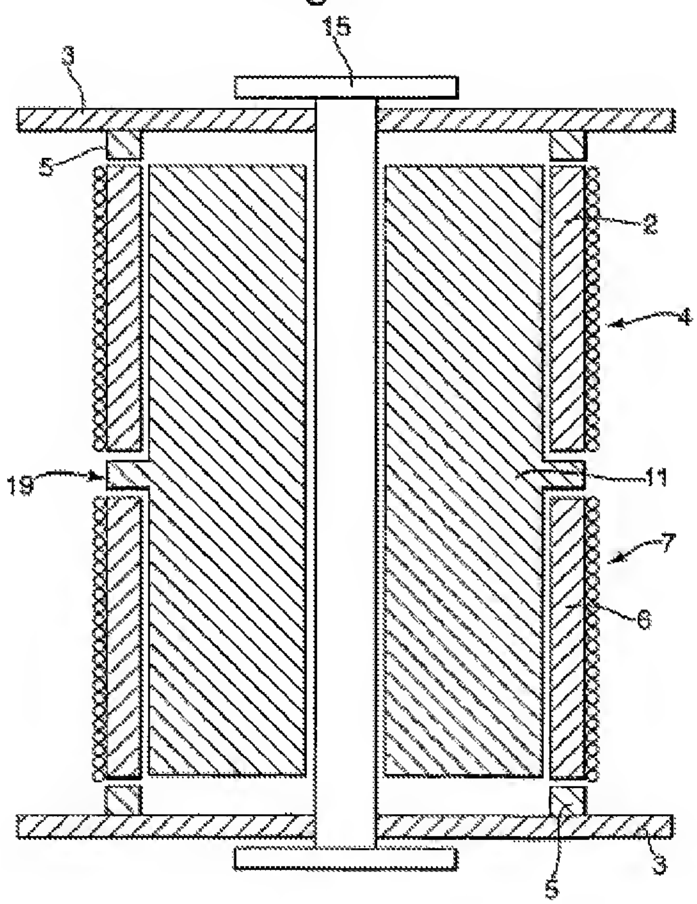
Cylindrical member (7) is wound with a single or multilayered length of optical fibre (23). (*See, e.g.,* page 4, lines 16-20). The optical fibre (23) is wound about an external surface (25) of the cylinder (7) and may be secured mechanically, adhesively or through another or combination of techniques to ensure that as completely as possible the possibility of slippage between the fibre (23) and the cylinder surface (25) is minimised. (*See, e.g., Id.*).

In operation, the optical fibre (23) constrains cylindrical member (7) against circumferential deformation thus generating a level of hoop stress in the fibre (23). (*See, e.g.,* page 4, lines 22-31; Claims 1, 15). This hoop stress alters the physical characteristics of the optical fibre (23) such that by incorporating the accelerometer in one arm of an optical interferometer (Figure 3) a stress value proportional to the acceleration acting on accelerometer (1) can be determined. In this arrangement

compression of the compliant cylinder by displacement of the seismic mass effectively increases the stress in the optical fibre; conversely expansion of the compliant cylinder decreases stress in the optical fibre. (*See, e.g., Id.*).

Figure 4 below is another embodiment of this invention in which seismic mass (11) is located coaxially inside two separate cylinders (2, 6) of compliant material. (*See, e.g.*, page 5, lines 11-27).

Fig.4.



Each cylinder is surrounded by a separate length of optical fibre (4) and (7). (*See, e.g.*, Id.; Claim 9). The end faces of the two compliant cylinders nearest the centre of the sensor each rest on a bearer member (19) (in this case in the form of a circumferential protrusion from the mass extending outwardly from the seismic mass). (*See, e.g.*, *Id.*; Claims 10-12). While a single bearer member is shown bearing on one end of each cylinder, clearly two separate bearer members may be employed to bear on each of the respective complaint cylinders. (*See, e.g. Id.*). The bearer member transfers the effects of the axial displacement of the mass to each of the complaint

cylinders. The opposite end of each compliant cylinder is in contact with separate support rings (or more generally end support members) which are themselves attached to two end plates (3), one of which is situated at either end of the accelerometer. (*See, e.g., Id.*). A tensioning device (15) is used to pull the two end plates together so that when the accelerometer is stationary both of the compliant cylinders are in a state of compression. (*See, e.g., Id.*).

In the accelerometer, acceleration in one axial direction will increase the axial compression in one compliant cylinder and decrease it in the other, and so the effects induced in the two fibre coils (4, 7) will be equal in magnitude but opposite in sense. If the two fibre coils are used in two different arms of an interferometer, (33) and (34) in Figure 3, the changes in the two coils will add together and so the sensitivity of the accelerometer will be twice as a large as if a single coil were used in one arm of the interferometer. This embodiment also has the advantage that if the accelerometer experiences an acceleration orthogonally to the axis, any signals induced in the two fibre coils will tend to cancel out if they are used in separate arms of an interferometer. As in the embodiment of Figure 2, in this arrangement compression of a compliant cylinder by displacement of the seismic mass effectively increases the stress in the optical fibre wound around the cylinder. Conversely reducing the compression applied to a compliant cylinder decreases stress in the optical fibre.

In use, acceleration forces acting on seismic mass (13) bring about a displacement which is coupled to the cylindrical member (7). (*See, e.g.*, page 5, line 29 to page 6, line 2). In effect, the tension member (15) preloads the cylindrical member (7) with an initial displacement. Depending on the range of acceleration expected, the preload may be varied by altering the level of tension provided by the tension member (15). (*See, e.g., Id.*) In one particular use, the accelerometers of this invention are employed optical interferometers. In particular, the accelerometer (1) is an element of an optical interferometer (30) that is used to determine acceleration. (*See, e.g.*, page 4, lines 33-37; Figure 3; Claim 14) In this use, there is a source of laser light (31) a coupler (32) coupling two arms (33, 34) of fibre optic cable and an output to a display (35). One of the arms (33) contains the accelerometer (1) whilst the other arm (34) includes a polarisation corrector (36). (*See, e.g.*, *Id.*).

VI. GROUNDS OF REJECTION TO BE REVIEWED ON APPEAL

The grounds of objection/rejection to be reviewed on appeal are twofold.

The first ground of rejection for review on appeal is whether claims 1, 3-12, 14-15, 17, 20 and 22 are anticipated by Thomas (WO 03/081186) under 35 USC 102(b).

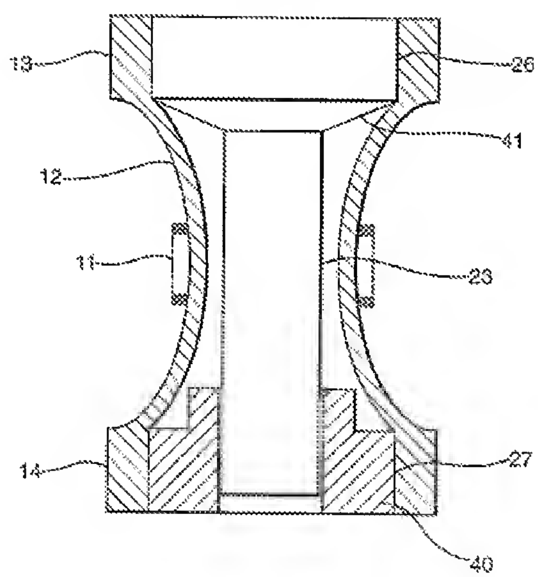
The second ground of rejection for review on appeal is whether claim 21 is anticipated by Thomas (WO 03/081186) under 35 USC 102(b).

VII. APPLICANT'S ARGUMENTS IN FAVOR OF CLAIM PATENTABILITY

A. The Thomas (WO 2003/081186) Reference

By way of brief review, Thomas describes a fibre optic accelerometer having a mass contained within a flextensional body in the form of a concave tapered cylinder. Figure 4 of Thomas is reproduced below.

Fig.4.



In Figure 4, a coil of optic fibre (11) is wound circumferentially around a tapered cylinder. Thomas explains, at page 6, lines 26-36 and at page 7, lines 34-35 that radial deformation of the concave cylinder occurs under axial displacement because of the shape function and geometry of the concave cylinder. It would be immediately apparent to one skilled in the art at the time of the invention based upon this Thomas disclosure that because of the concave shape taught in Thomas, axial compression of the cylinder – that is compression at one or both ends of the

device - by the seismic mass in Thomas will result in the concave walls flexing inwards towards the axis passing through the device with a resulting <u>decrease</u> in tension in the optic fibre.

B. Summary Of The Examiner's Rejection

The examiner rejected Claims 1, 3-12, 14, 15, 17 and 20-22 under 35 U.S.C. 102(b) as being anticipated by Thomas. Of the rejected claims, claims 1, 15 and 21 are independent claims.

As to independent claim 1, it is the examiner's position that Thomas discloses a fibre optic accelerometer (10) comprising a seismic mass (23) coaxially constrained within a cylinder (12) of compliant material , arranged to prevent the cylinder deforming inwardly under axial compression (Figures 1-7; page 6, line 22 - page 7, line 28), the cylinder (12) being circumferentially wound with optical fibre (11) (figures 1-7; page 2, line 18 - page 3, line 3; page 6, line 6 - page 8, line 9), such that axial compression of the cylinder (12) by the seismic mass (23) increases stress in the optical fibre (11) (figures 1-7; page 7, line 12-22).

As to independent claim 15, it is the examiner's position that Thomas discloses a method of measuring acceleration comprising providing a seismic mass (23) coaxially constrained within a cylinder (12) of compliant material, the cylinder (12) being circumferentially wound with optical fibre (11), axially displacing the seismic mass (23) so as to compress the cylinder (12) thereby increasing the stress induced in the optical fibre (11) and determining a stress value in the optical fibre (11) (figures 1-7; page 2, line 18 - page 3, line 3; page 6, line 6 - page 8, line 9).

As to independent claim 21, it is the examiner's position that Thomas discloses a fibre optic accelerometer (10) comprising a body of compliant material having an internal cavity extending in an axial direction (figures 1-7; page 8, lines 5-9); optical fibre (11) wound circumferentially around said body (figures 1-7; page 6, lines 6-31); and a seismic mass (23) located within said cavity, wherein the internal surface of said cavity is constrained against radial displacement (figures 1-7; page 6, line 6 - page 8, line 9).

C. Errors in the Examiner's Final Rejections

In order for a reference to anticipate, the reference must show the same invention in as complete a detail as claimed. *Richardson v. Suzuki Motor Co.,* 868 F.2d 1226, 1236, 9 USPQ2d 1913, 1920 (Fed. Cir. 1989). Moreover, the elements must be arranged in the reference as required by the claim. *In re Bond*, 910 F.2d 831, 15 USPQ2d 1566 (Fed. Cir. 1990). The examiner's rejection of claims 1, 3-12, 14-15, 17, 20 and 22 for being anticipated by Thomas

must be rejected at Thomas does not disclose the claimed invention. In particular Thomas at least does not disclose a "cylinder being circumferentially wound with optical fibre such that axial compression of the cylinder by the seismic mass increases stress in the optical fibre" as set forth in independent claims 1 and 15. In addition, the examiner's anticipation rejection of claim 21 must be rejected at least because Thomas does not disclose an accelerometer including a seismic mass that is located in a cavity wherein "the internal surface of said cavity is constrained against radial displacement".

1. The Examiner's Anticipation Rejection Of Claims 1, 3-12, 14-15, 17, 20 And 22 Must Be Dismissed Because Thomas Does Not Disclose A Device Whereby Axial Compression Of The Device Cylinder By A Seismic Mass <u>Increases</u> Stress In The Optical Fibre

Independent claims 1 and 15 are both novel and patentable because Thomas does not disclose or suggest devices and methods whereby axial compression of the device cylinder by the seismic mass <u>increases</u> stress in the optical fibre. What Thomas discloses is a fibre optic accelerometer having a mass contained within a flextensional body in the form of a concave tapered cylinder. Optic fibre is wound circumferentially around the tapered cylinder. Thomas explains, at page 6, lines 26-36 and at page 7, lines 34-35 that radial deformation of the concave cylinder occurs under axial displacement because of the shape function and geometry of the concave cylinder. Based upon this description, it would be immediately apparent to one skilled in the art at the time of the invention that, because of the concave shape taught in Thomas, compression of the cylinder by the seismic mass in Thomas will result in a <u>decrease</u> in tension in the optic fibre. In other words, compression along the axis at one or both ends of the device in Thomas will result in the concave walls flexing inwardly towards the axis (ever so slightly reducing the diameter of the shell in the location of the fibre optic winding with a resulting <u>decrease</u> in tension in the optic fibre. Thus Thomas does not disclose the feature of claim 1 that axial compression of the cylinder by the seismic mass <u>increases</u> stress in the optical fibre. It is for at least this reason that independent claims 1 and 15 are not anticipated by Thomas.

2. The Examiner's Rebuttal Position Is Legally And Technically Flawed

The examiner considered Applicant's position that Thomas does not disclose this feature of claims 1 and 15 and rebutted Applicant's position by alleging that Thomas <u>implies</u> an increase in stress in the optical fibre upon axial compression. (See page 2 of the May 26, 2009 Final

Rejection). Claims 1 and 15 are novel in view of even the examiner's rebuttal position because the rebuttal position is both legally and technically flawed.

a. The examiner's rebuttal position is legally flawed

In order for a reference to anticipate in terms of 35 U.S.C. Section 102, **<u>every</u>** **<u>element</u>** of the claimed invention **<u>must</u>** be **<u>identically</u>** shown in a single reference." *Diversitech Corp. v. Century Steps, Inc.*, 850 F.2d 675, 677, 7 U.S.P.Q.2d 1315, 1317 (Fed. Cir. 1988). It is possible for a reference to anticipate where one or more of the claimed elements is inherent from the prior art. The examiner here has alleged that the claim feature "the cylinder being circumferentially wound with optical fibre such that axial compression of the cylinder by the seismic mass increases stress in the optical fibre" is "implied" from the prior art. However, whether or not the prior art "implies" a claim feature is irrelevant to proof of anticipation. This is because the law does not recognize an "implied" feature. For at least this reason, the examiner's anticipation position is legally flawed and must be withdrawn.

b. The examiner's rebuttal position is technically flawed

In order for a prior art reference to have an inherent feature or step, a structure or step in the prior art must <u>necessarily function</u> in accordance with the anticipated claim feature. *In re King*, 231 USPQ 136, 138 (Fed. Cir. 1986). This is not the case with the cited prior art. The prior art device cannot be said to function as claimed because the examiners understanding of the function of the Thomas device is technically flawed.

The examiner takes the position in the Final Rejection that "since suspension system 25 [of Thomas] prevents axial displacement within the cylinder (12), the cylinder would end up bulging at it's center due to axial compression thereby increasing stress in the optical fibre coil (11)." The examiner's understanding of the operation of the Thomas device is this regard is technically wrong. In Thomas, axial compression of the device is converted into radial displacement at the centre of the cylinder according to the shape function of the geometry of the cylinder. This radial displacement in Thomas is not due to bulk material deformation (as in the present invention) but instead due to the flextensional geometry of the staves i.e., due to bending of the staves (the cylinder of Thomas is not solid but sliced into staves). As a result, in Thomas, axial compression of the device results in a <u>reduction</u> of the circumference of the cylinder at the location of the optic fibre, thereby causing a <u>decrease</u> in hoop or tensile stress of the fibres.

Concerning the suspension system (25) of Thomas, on which the Examiner bases certain arguments, it is noted that the examiner's technical positions regarding the operation of Thomas are contradictory. At the top of page 3 of the Final Rejection, the examiner states that "suspension system (25) prevents axial displacement". At the bottom of the same page, and spanning page 4 also, the Examiner quotes Thomas as disclosing "a suspension system (25) to prevent sideways motion but allow axial motion of the device". The examiner's position in this regard is illogical because the same system (25) of Thomas cannot, as the examiner alleges, simultaneously prevent and allow axial motion. There is, therefore, no technical basis in Thomas to support the examiner's 'bulging' allegation.

To clarify, suspension system (25) of Thomas acts between one end of the cylinder (12) and the mass (23) to prevent sideways motion there between. In other words, the suspension system ensures that the two components remain coaxial. The suspension system is specifically designed to allow relative axial displacement. It should be noted, however, that suspension system (25) does not prevent radial displacement <u>at the centre</u> of the cylinder at the location of the fibre coil (11). This radial displacement occurs with no sideways motion – i.e. the cylinder and mass remain coaxial. This is completely clear from the description and drawings of Thomas, particularly Figure 3.

For each of the reasons recited above, independent claims 1 and 15 are novel and patentable. Dependent claims 3-12, 17 and 20 are novel and patentable at least by virtue of their dependence upon one of independent claims 1 or 15.

3. Independent Claim 21 Is Novel and Patentable

Independent claim 21 is novel and patentable at least because Thomas does not disclose a device "wherein the internal surface of said cavity is constrained against radial displacement" as required by claim 21. Looking at Thomas, for example Figures 2 and 4, it can clearly be seen that there is nothing preventing the internal surface of concave cylinder 12 from deformation – an area of free space exists between cylinder 12 and mass 23. This is completely unsurprising, since in order for the device of Thomas to function as described, the internal surface of the cylinder must be free of obstruction to allow the cylinder to deform <u>inwardly</u> under axial compression of the cylinder. Thus independent claim 21, and claim 22 which depends upon claim 21 are novel at least because the referenced feature of claim 21 above is absent from Thomas.

The examiner rebuts applicant's patentability position by asserting that Thomas clearly intends to constrain the cavity against radial displacement by disclosing "a suspension system (25) to prevent sideways motion but allow axial motion of the device". (Citing Thomas at page 6, lines 18-20). The examiner's rebuttal argument is again based upon a misunderstanding about the teachings of Thomas. In Thomas, the inner surface of the cylinder cavity is <u>not</u> radial constrained. Radial motion (as opposed to sideways motion) is necessary for operation of the device of Thomas. Suspension system (25) of Thomas, as has been explained above, prevents net sideways displacement <u>at the end</u> of the cylinder. As is abundantly clear from Figure 2 of Thomas, radial displacement at the centre of the cylinder, due to bending (buckling) of the barrel stave, still occurs even though the end of the cylinder or barrel stave is laterally constrained. For at least these reasons independent claim 21 and dependent claim 22 are novel and patentable.

CONCLUSION

The Board should dismiss the examiner's rejection of all pending application claims for lack of novelty because the Thomas reference, relied upon by the examiner to reject all claims does not disclose every features of the claimed invention either expressly or inherently.

Date: June 23, 2010

By _/A. Blair Hughes/________
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312-913-2123

CLAIMS APPENDIX

1. A fibre optic accelerometer comprising a seismic mass coaxially constrained within a cylinder of compliant material, arranged to prevent the cylinder deforming inwardly under axial compression, the cylinder being circumferentially wound with optical fibre such that axial compression of the cylinder by the seismic mass increases stress in the optical fibre.

3. An accelerometer according to Claim 1, wherein the seismic mass includes a disc shaped portion.

4. An accelerometer according to Claim 1, wherein the seismic mass is secured by a tension member to a base plate.

5. An accelerometer according to Claim 4, wherein a spacer is provided between the cylinder and the base plate.

6. An accelerometer according to Claim 5, wherein the spacer is integral with the base plate.

7. An accelerometer according to Claim 1, wherein the optical fibre is wound in a single layer.

8. An accelerometer according to Claim 1, wherein the base plate is integral with a platform or structure.

9. An accelerometer according to Claim 1 in which the seismic mass is coaxially constrained within first and second cylinders of compliant material, each cylinder being circumferentially wound with optical fibre.

10. An accelerometer according to claim 9 in which the seismic mass comprises a first circumferentially located bearer member arranged to bear on an end of at least one of the compliant cylinders.

11. An accelerometer according to claim 10 in which the first circumferentially located bearer member is arranged to bear on respective ends of both of the compliant cylinders.

12. An accelerometer according to claim 10 comprising a second circumferentially located bearer member arranged to bear on an end of a second of the compliant cylinders.

14. An optical interferometer comprising an accelerometer according to claim 1.

15. A method of measuring acceleration comprising providing a seismic mass coaxially constrained within a cylinder of compliant material, the cylinder being circumferentially wound with optical fibre, axially displacing the seismic mass so as to compress the cylinder thereby increasing the stress induced in the optical fibre, and determining a stress value in the optical fibre.

20. A fibre optic accelerometer according to Claim 1, wherein said compliant material is rubber or rubber like.

21. A fibre optic accelerometer comprising a body of compliant material having an internal cavity extending in an axial direction;

optical fibre wound circumferentially around said body; and

a seismic mass located within said cavity; wherein the internal surface of said cavity is constrained against radial displacement.

22. A fibre optic accelerometer according to Claim 20, wherein the internal surface of the cavity is constrained by the seismic mass.

EVIDENCE APPENDIX

(None)

RELATED PROCEEDINGS APPENDIX

(None)